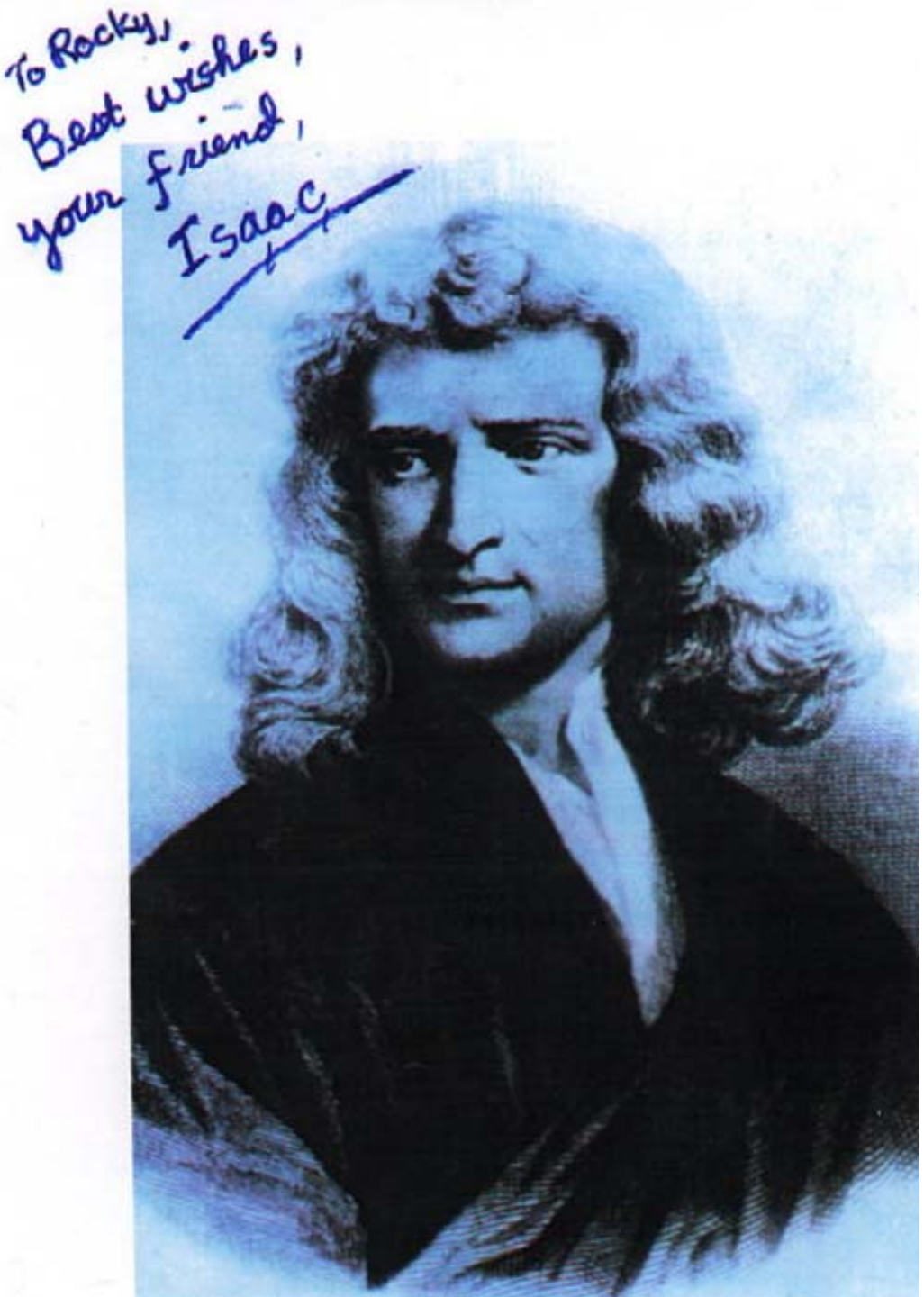


Isaac Newton
1642-1727

Insane in the Membrane?

Philosophiæ Naturalis Principia Mathematica

(1687)

Exam #1 Thursday April 22

- Readings (Kolb, Chapters 1-5)
- Class lectures
- Class images (website)
- Dialog Concerning Two Chief World Systems (website)
- Laboratory work (Moons of Jupiter)
- Little (if any) mathematics this time
- We will provide calculators

Lab next two weeks: Temperature of the Universe

1. **Astronomers were doing more than "saving the appearances."**

2. **The same laws of physics operate on Earth as in the heavens.**

3. **The heavens are comprehensible by humans.**

4. **Crystalline spheres, mechanical gears, and other sundry devices were replaced with a simple mathematical force law.**

5. **The physics of Aristotle and the astronomy of Ptolemy were relegated to the dust bin.**

Why did the revolution occur; was it inevitable?

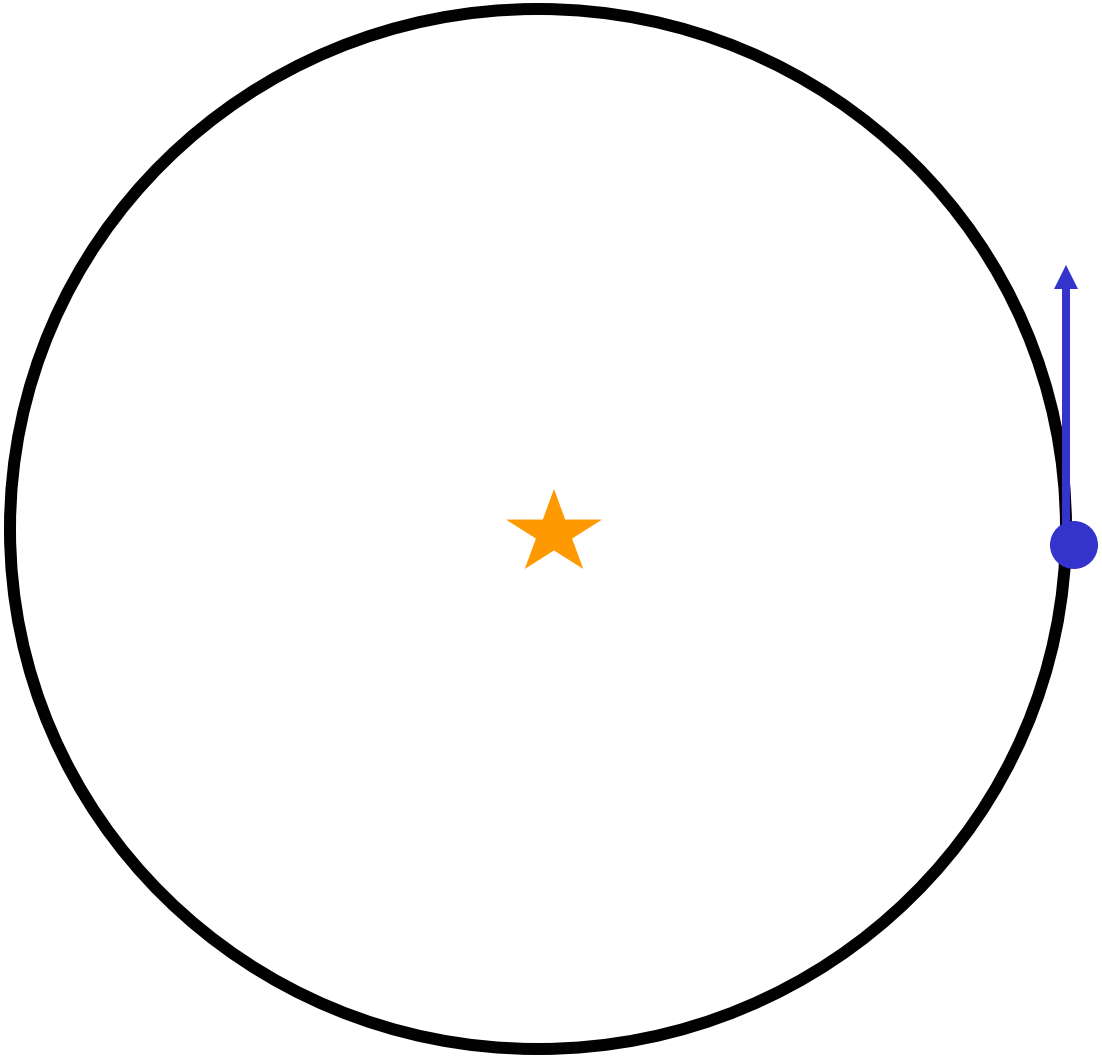
Why did it occur in Western Europe?

Why did it occur when it did?

How would it have played out without Copernicus, Tycho, Kepler, Galileo, or Newton?

Will we ever develop a better way to do science?

violent motion
natural motion



in absence of a force, planet would

1. **slow to a stop?**
2. **continue to orbit?**
3. **fly off in a straight line?**

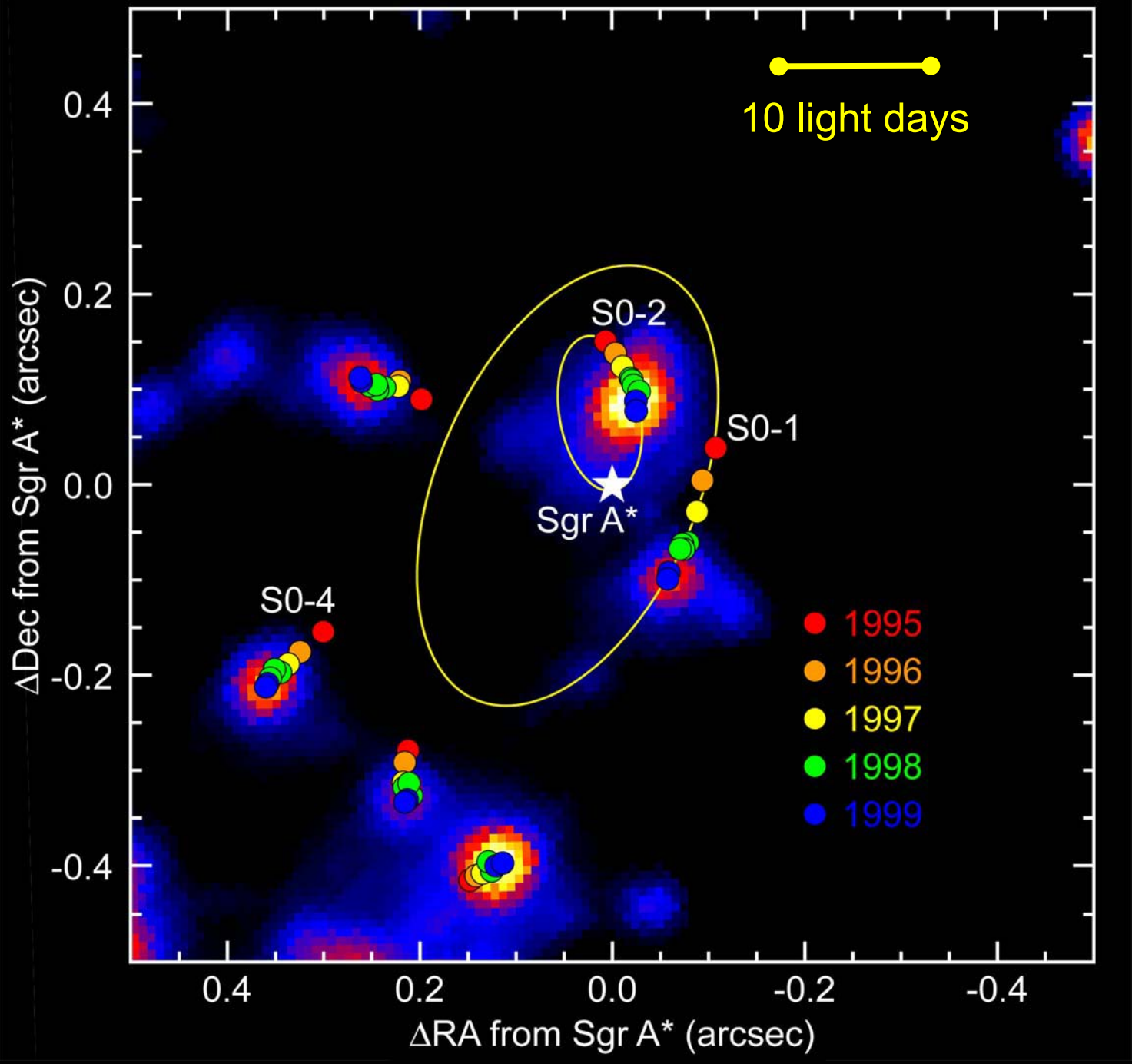
PHILOSOPHIÆ NATURALIS PRINCIPIA MATHEMATICA.

Autore *J. S. NEWTON, Trin. Coll. Cantab. Soc.* Matheseos Professore *Lucasiano*, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, *Reg. Soc.* PRÆSES.
Julii 5. 1686.

LONDINI,
Jussu *Societatis Regiæ* ac Typis *Josephi Streater*. Prostat apud plures Bibliopolas. *Anno* MDCLXXXVII.

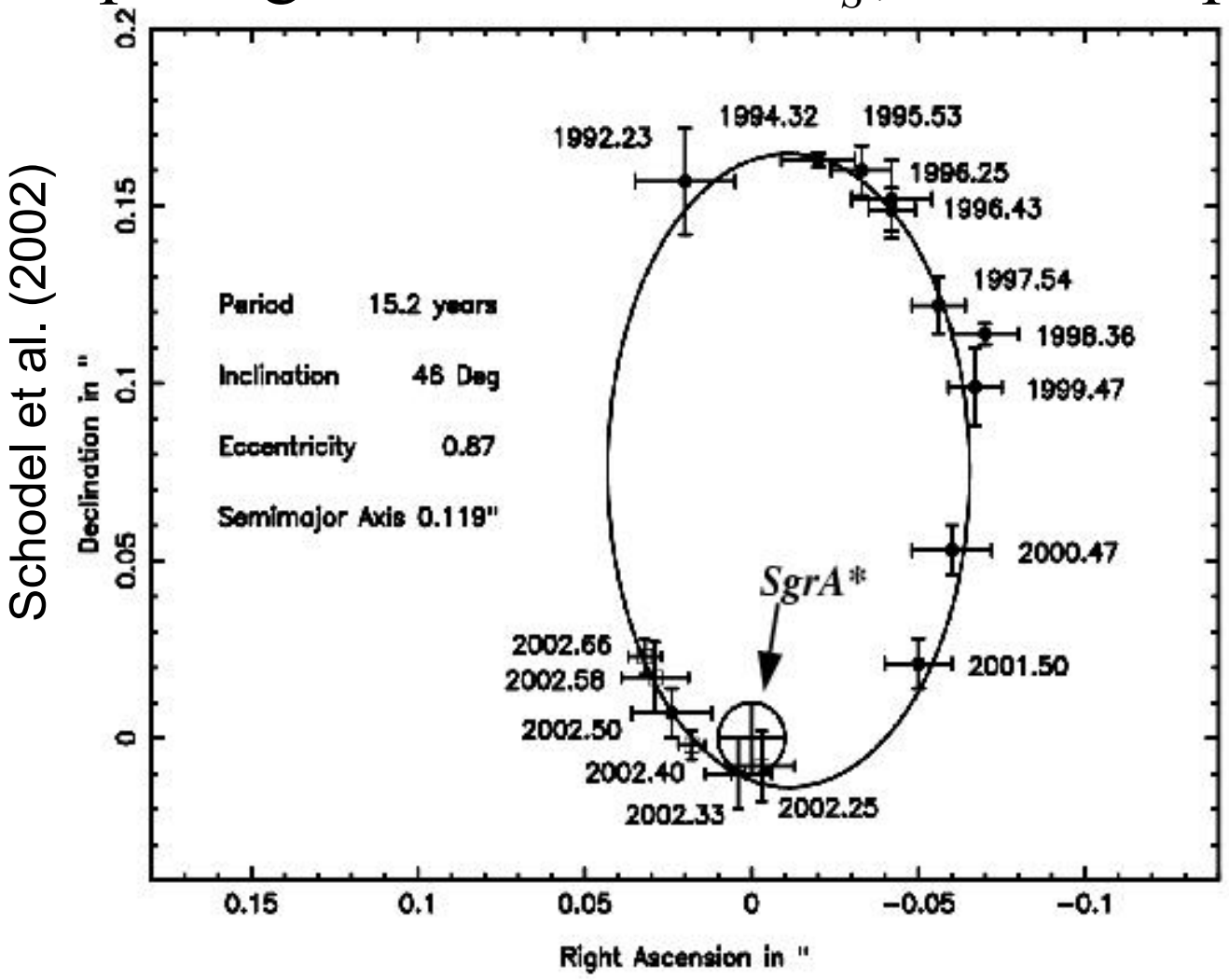
Ghez et al.

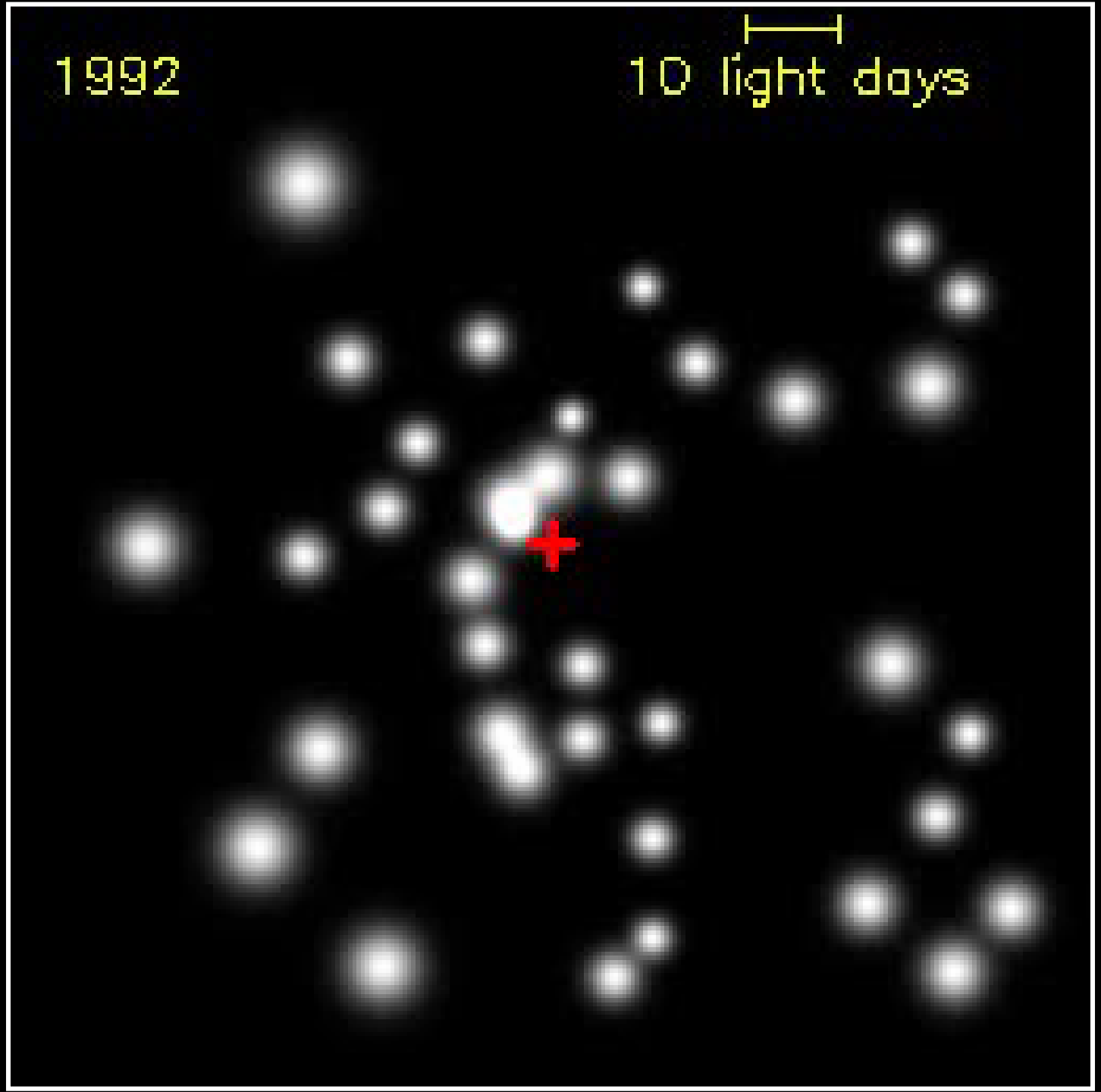

10 light days
S0-2
S0-1
Sgr A*
S0-4
1995
1996
1997
1998
1999
0.4
0.2
0.0
-0.2
-0.4
ΔDec from Sgr A* (arcsec)
ΔRA from Sgr A* (arcsec)

Orbits near the galactic center

$S2$: $15M_{\odot};7R_{\odot}$ Black Hole mass $M = 2.6\times10^{6}$ $M_{\odot}$

Pericenter passage: $100\text{AU}=2000R_{S};11\times10^{6}$ mph





Schodel et al. 2002

1992

10 light days

Schodel et al. 2002

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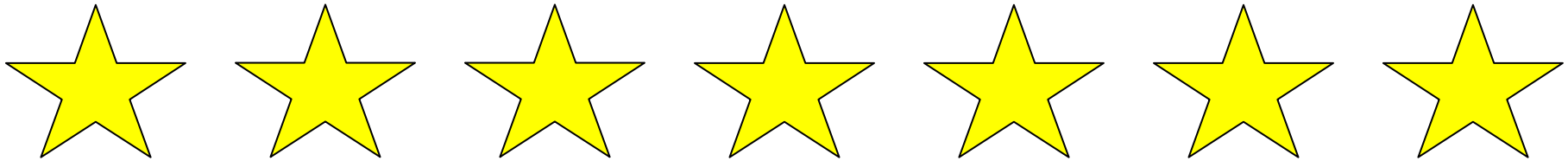
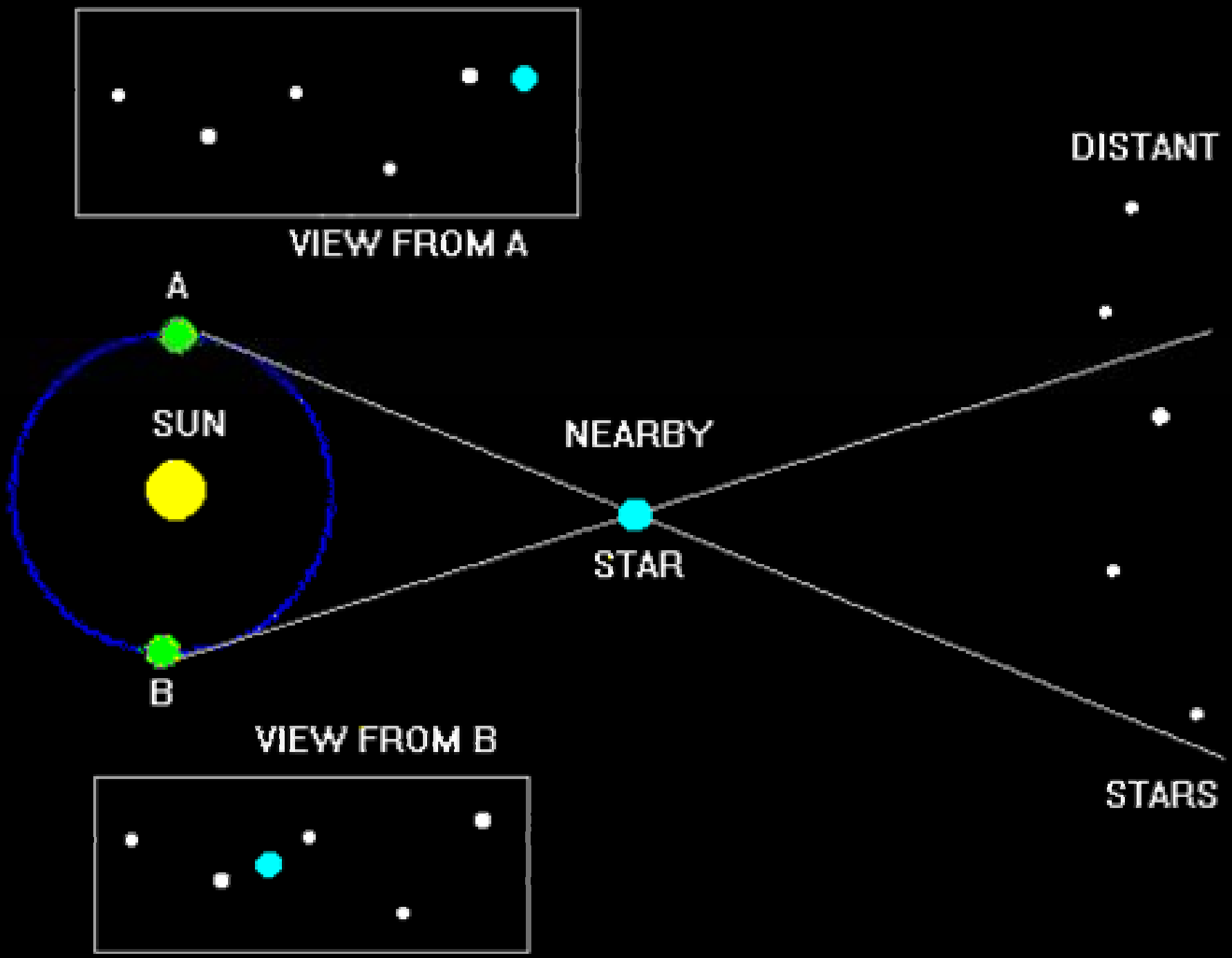
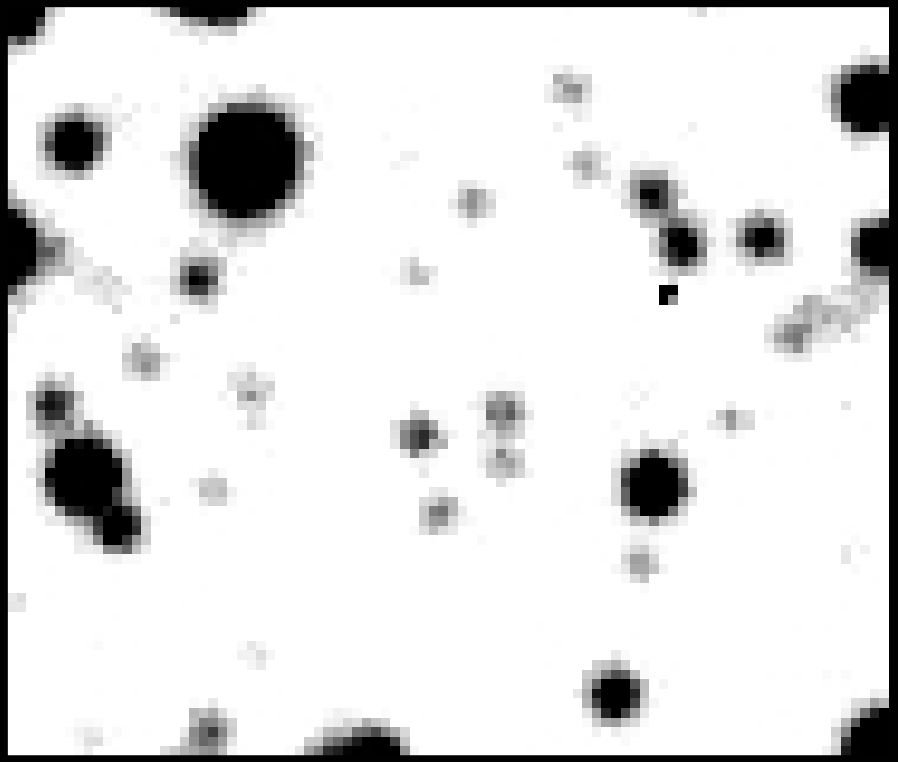


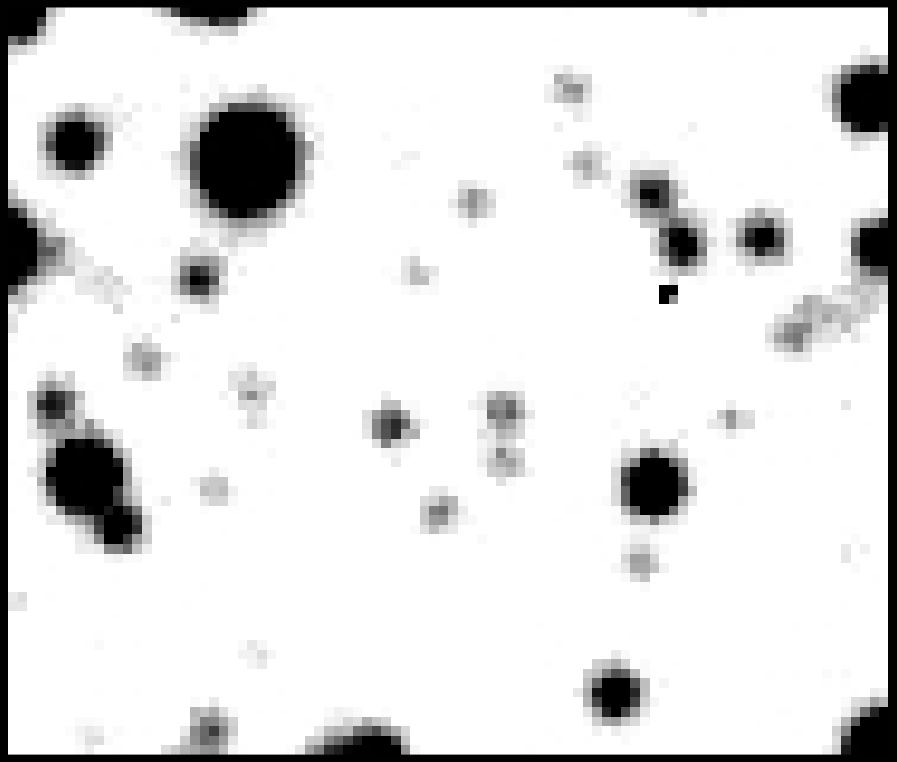
1 2 3 4 5 6 7


VIEW FROM A
DISTANT
A
SUN
NEARBY
STAR
B
VIEW FROM B
STARS

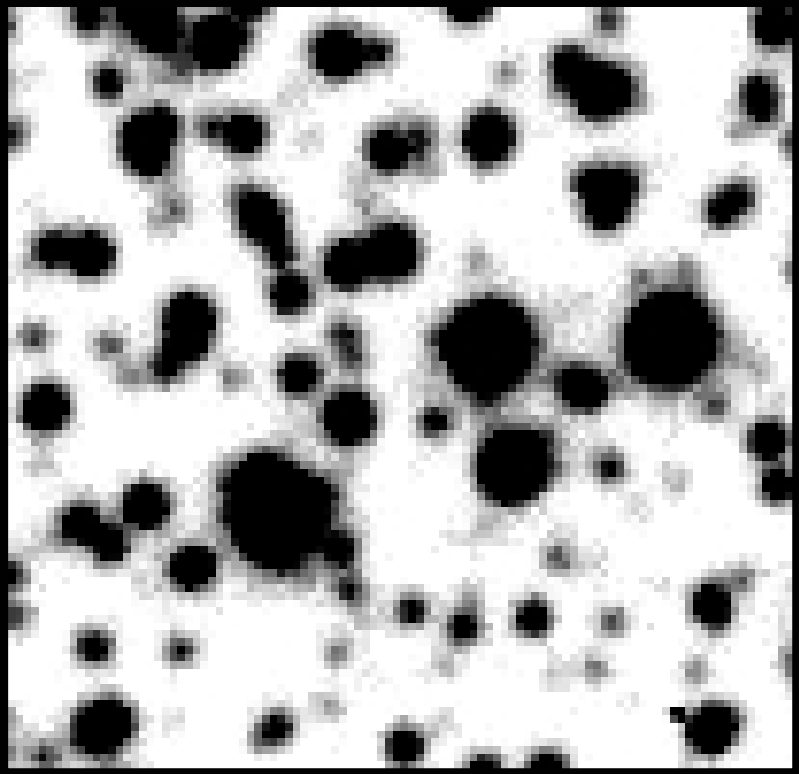
January



June



January



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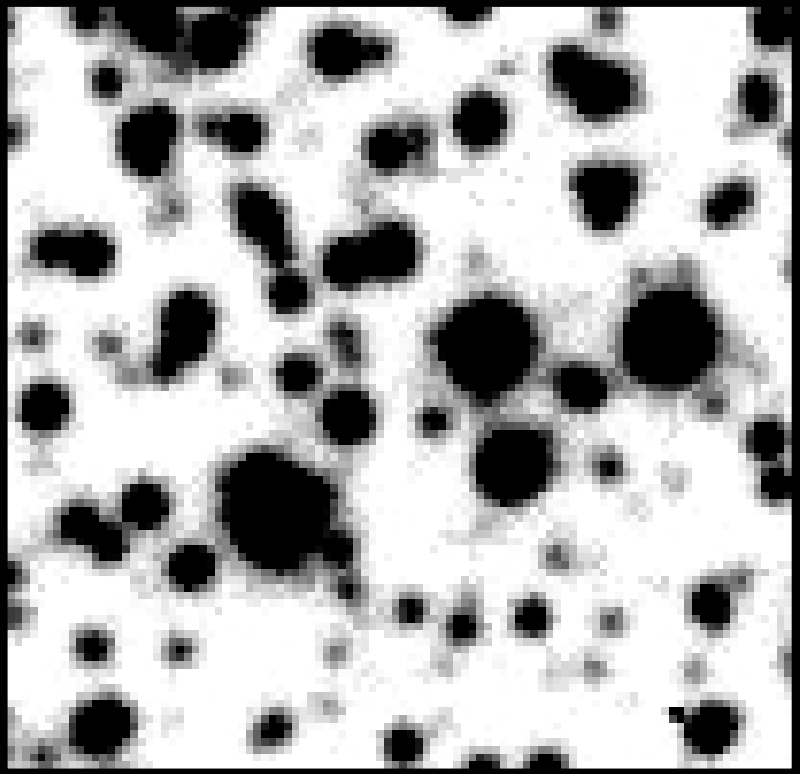
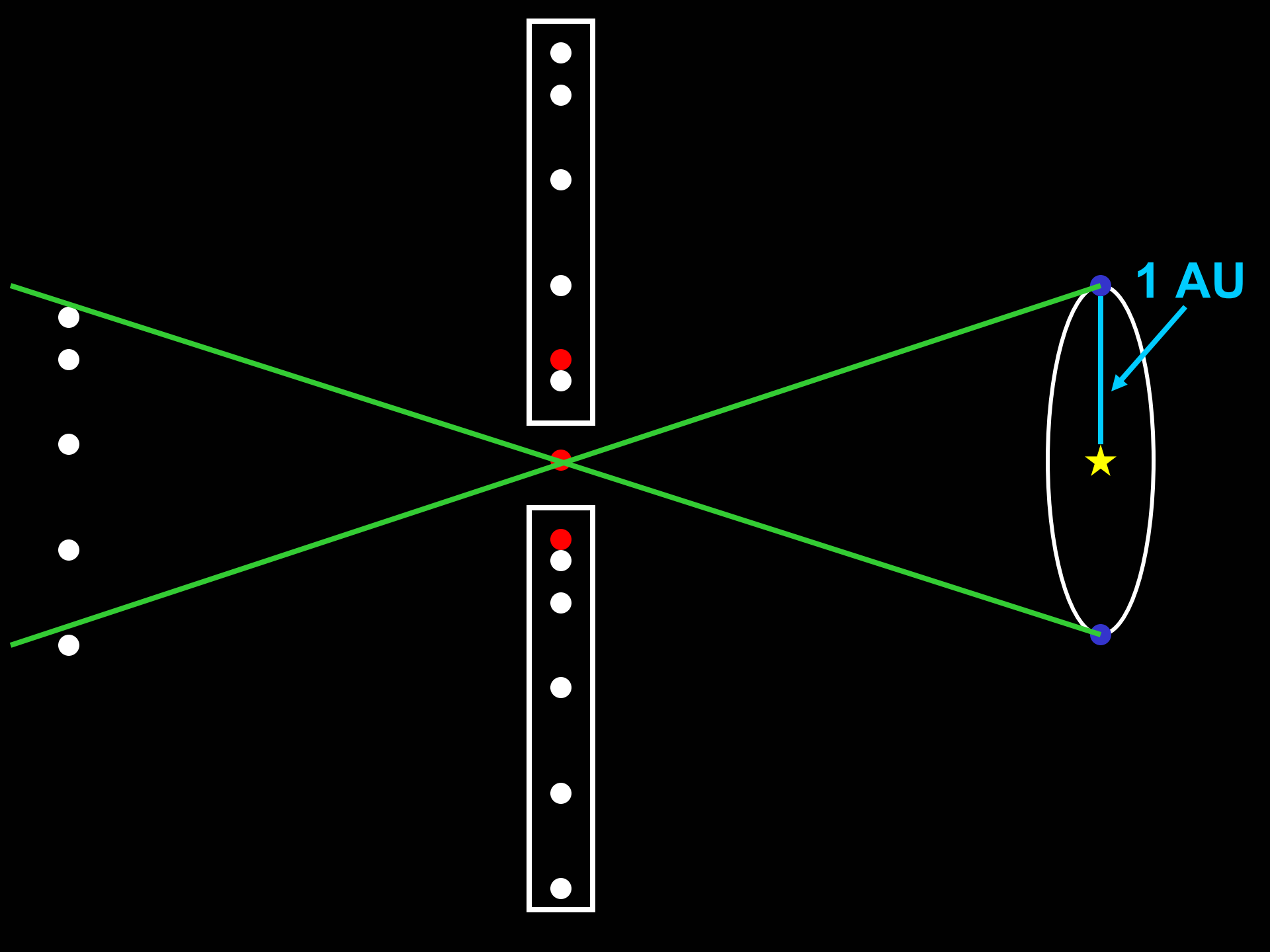
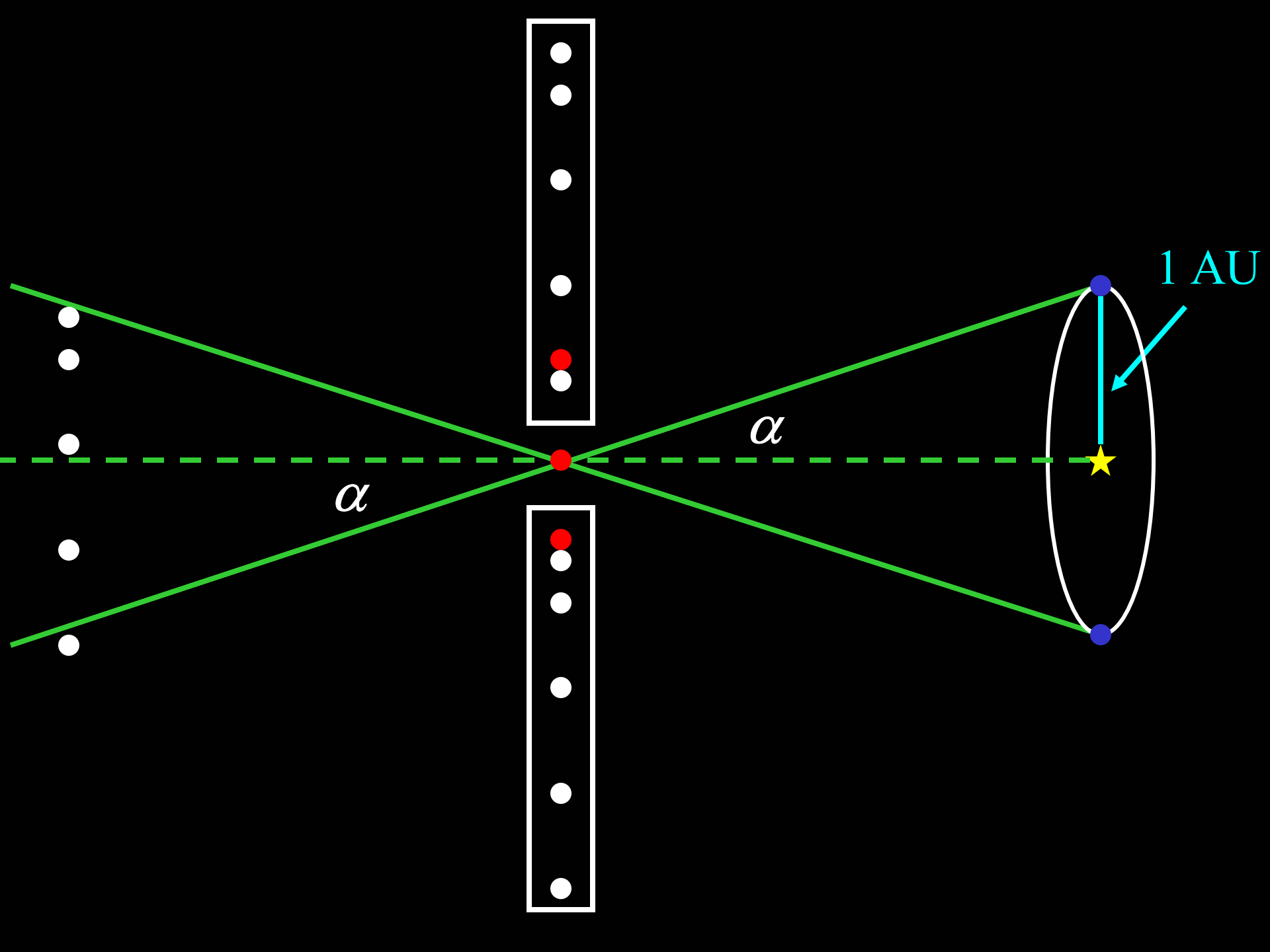
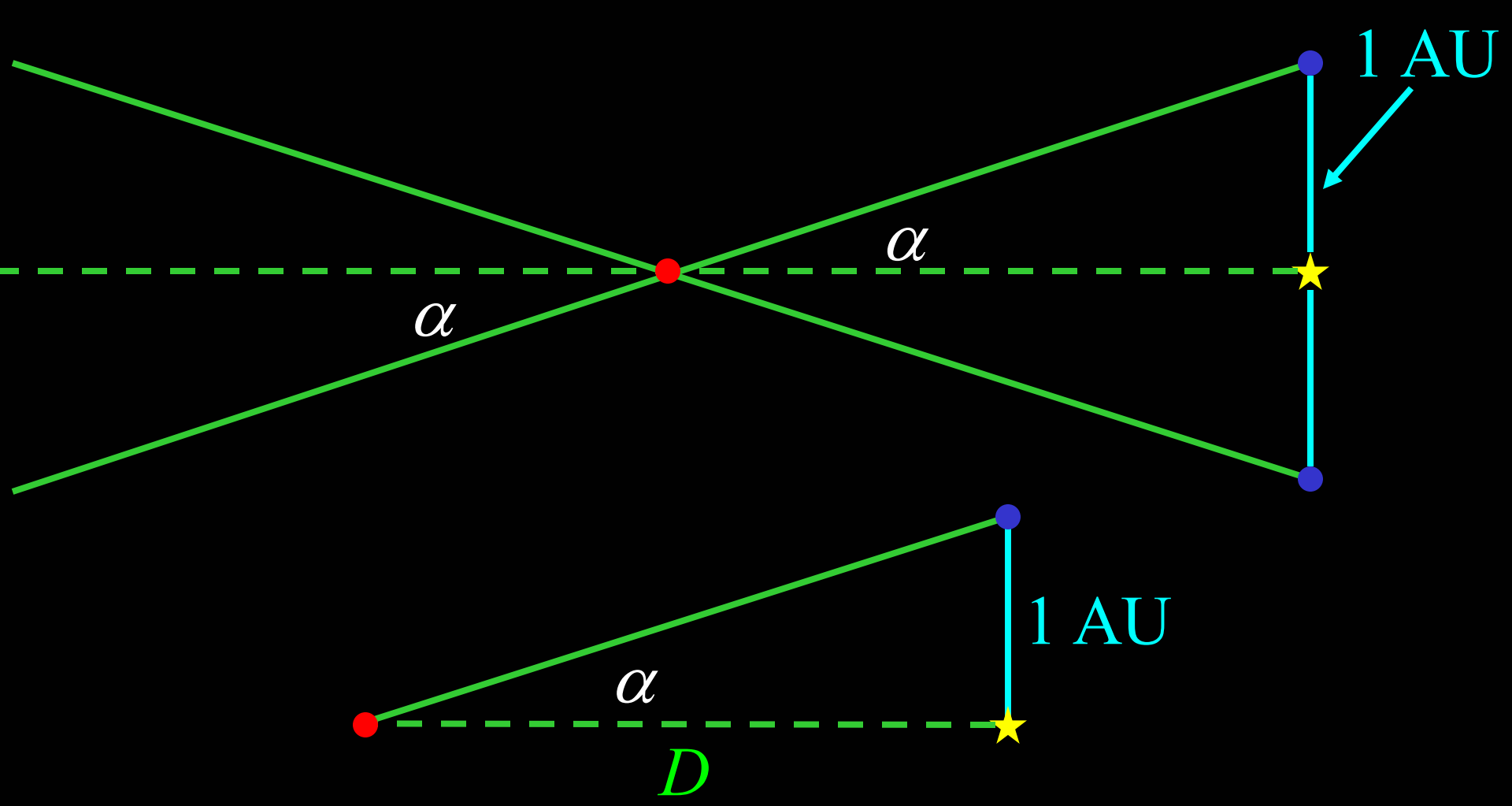
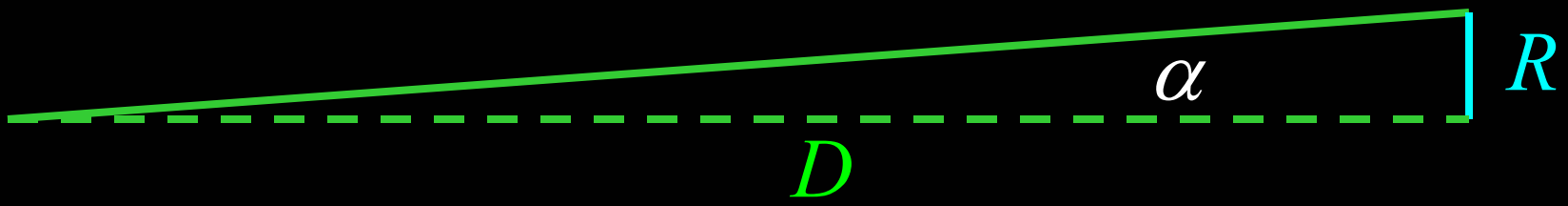



1 AU


1 AU
α
α



$$\tan\alpha = \frac{1\ \text{AU}}{D}$$



$$\tan\alpha = \frac{R}{D}$$

law of skinny triangles:

$$\tan\alpha = \sin\alpha = \alpha \quad \text{(in radians)}$$

$$\alpha \quad \text{(in radians)} = \frac{R}{D}$$

What's a radian?

2π radians = 360 degrees

$$1 \text{ radian} = \frac{360}{2\pi} \text{ degrees} = 60 \text{ degrees}$$

$$0.01 \text{ radians} \times \frac{60 \text{ degrees}}{1 \text{ radian}} = 0.6 \text{ degrees}$$

$$3 \text{ degrees} \times \frac{1 \text{ radian}}{60 \text{ degrees}} = 0.05 \text{ radians}$$